

The Spatial Characteristics of Traditional Villages and Their Heritage Protection based on Landscape Genes

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Abstract: - The landscape genes are born from the genetic concept of biology and can play an active role in the internal mechanism and external expression of the spatial characteristics of traditional settlements. The landscape genes are the key elements to distinguish the characteristics of each type, and the emphasis on the causes of the evolution of material forms and spatial and temporal conditions can, to a certain extent, effectively help to study the regular characteristics of the traditional village landscape. Based on landscape genes, this paper studies the spatial characteristics of traditional villages and their inheritance and protection mechanisms, to construct a traditional village landscape genetic system and verify its scientificity by taking Huizhou traditional villages as an example. In order to provide some reference for the study of spatial characteristics of traditional villages and the inheritance and protection of traditional villages.

Key-Words: - landscape genes, traditional villages in Huizhou, identification system, landscape characteristics

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1 Introduction

Huizhou, originally inhabited by the ancient Yue people, was forced by frequent wars to move a large number of people from the Middle Kingdom into the area, [1]. During this period, the culture of the Central Plains, the minority culture, and the local ancient Yue culture began to intermingle. The village layout and architectural forms were also influenced by intermingled cultures. The natural topography of Huizhou mountains and rivers and water network restricts people to live in the micro plains among the mountains and the undulating terrain, and the harsh living status and limited transformation ability, the villages can only choose the free-form layout suitable for the environment. Influenced by the natural environment and history and humanities, there are still the most well-preserved ancient villages in Huizhou, such as: Xidi and Hongcun, the "Painted Countryside", Chengkan, the "First Village in the South", Shuikou, the "First Village "Tang Mode" and so on. These ancient villages with long historical and cultural backgrounds hide unique landscape genes, which can be effectively used in contemporary construction after identification, thereby building modern towns with unique regional cultures, [2]. In recent years, a series of important achievements have been made in the research of the "landscape gene map" of Chinese traditional villages combined

with GIS technology. However, the research on the landscape genes of Huizhou ancient villages focuses on the identification and extraction methods, such as the basic knowledge and extraction from the perspective of cultural geography, Nie uses the biological gene sequence, and the spatial characteristic analysis of Huizhou ancient villages is not deep enough. This paper analyzes the genetic perspective of the village landscape, aiming at the environmental and cultural factors of the village, and uses the landscape gene identification method to identify the unique regional cultural characteristics of the village. This paper dissects the landscape characteristics of Huizhou traditional villages based on the perspective of landscape genes and explores the connection between the landscape texture of Huizhou culture and the village landscape. It provides a more effective way for the deep excavation and scientific expression of the internal characteristics of Huizhou traditional villages and provides solid theoretical support and practical guidance for the inheritance and protection of the landscape of Huizhou traditional villages.

2 Spatial Morphology Analysis Method of Traditional Villages

2.1 The Quantitative Analysis of Traditional Village Spatial Patterns

At present, the quantitative analysis of traditional village spatial patterns is an important research method to interpret the inner rules of traditional village spatial patterns, including GIS technology, geometric pattern index analysis method, landscape pattern index analysis method, spatial sentence method, and spatial parameterization analysis method (Table 1).

Table 1. Quantitative research methods of traditional village space

Technical method	Space scale	Applicable to village objects
GIS technology	Village system and village area scale	The spatial system structure and spatial distribution pattern of the internal spatial elements of individual villages or the villages within the region
Geometric and morphological exponential analysis method	Village system and village area scale	The boundary of the spatial form and the flat form of a single village or the spatial distribution pattern of the villages within the region
Landscape pattern index analysis method	Village system	Individual or regional plot elements within the village
Spatial syntax	Village scale	Single village space form, street space, public space
Spatial parametric analytical method	Village scale	Parameter values of each element in the internal space of a single village

Among, Fractal theory is the use of fractal dimensions and mathematical methods to express shapes with complex geometric forms. In the study of the spatial morphology of traditional villages, [3], [4], the parameters of the geometric morphological index analysis method of fractal theory, i.e., boundary shape index and fractal dimension, are used to interpret the overall spatial morphological characteristics of traditional villages. The boundary

shape index reflects the closed graphic boundary of the village made by the combination of solid and imaginary elements of the external space of the village and is to evaluate the compactness of the village layout. Its calculation formula is as follows

The boundary shape index is calculated as:

$$S = \frac{P}{(1.5\lambda - \sqrt{\lambda} + 1.5)} \sqrt{\frac{\lambda}{A\pi}} \quad (1)$$

Where, S is the village boundary shape index, P the village boundary perimeter A the area, and λ the village aspect ratio. Fractal dimension is to reflect the complexity or fragmentation degree of the graph, reveals the complexity performance of the internal spatial elements of traditional villages, and reflects the spatial structure and internal spatial organization efficiency of traditional villages. Its calculation formula is as follows

Fractal dimension calculation formula.

$$D = \frac{2\lg\left(\frac{P}{4}\right)}{\lg(A)} \quad (2)$$

Where D denotes the fractal dimension value, P denotes the perimeter of the patch, and A denotes the area of the patch.

2.2 Traditional Village Spatial Morphology Gene Analysis Method

The analysis of the spatial morphological characteristics of traditional villages can be carried out from the physical geography of traditional villages in the region, the surrounding geography of individual traditional villages, and the spatial layout, structure, and internal spatial elements of villages. Therefore, traditional villages can be analyzed at three spatial levels: macroscopic, mesoscopic, and microscopic. In the analysis of spatial characteristics of traditional villages, the spatial distribution of traditional villages and their spatial relationship with natural environment elements are analyzed by GIS technology at the regional spatial scale to grasp the historical spatial pattern of villages in a lineage. In the overall spatial scale of the village, the landscape pattern index analysis method is to analyze the evolution of the elements of the parcel in the village space, but the spatial morphological structure of the traditional village is more stable due to the spatial environment and protection planning, so it is more reasonable to use the geometric morphological index analysis method to construct the overall geometric morphological structure of the village space and the internal spatial organization

efficiency. In the analysis of internal spatial elements of villages, the spatial parameterization analysis method is to analyze each element of the internal space of villages, but the result is the analysis of the characteristic difference of parameter values, lacking the exploration of the inner social and cultural order of spatial elements, while the spatial sentence method can effectively interpret this relationship and grasp the inner spatial relationship of village street space and public space, [5], [6]. Therefore, this study adopts GIS technology, spatial syntax, and geometric morphological index analysis to analyze the characteristics of spatial morphological genetic elements of traditional villages (Table 2).

Table 2. Table of spatial morphological genetic analysis methods of traditional villages

Spatial level	Elements	Technical method	Elements parsing
Macro level	geographical conditions	The GIS spatial analysis technique	Analyze the parameter values between the village spatial form layout and the external environment, and reveal the internal spatial relationship between the village spatial form and the geographical environment
Middle level	Plane boundary	Geometric and morphological exponential analysis method	Reactions to the compact of the overall outer outline of the village
	public space		It reflects the degree of spatial structure and the organizational efficiency of the village space
Microlevel	Street space	Spatial syntax	It reflects the spatial morphological characteristics of village streets and lanes and the structural characteristics of village public space
	public space		It reflects the change of the original spatial form characteristics by the village spatial form evolution
	Building courtyard		It reflects the internal spatial relationship of the traditional architectural structure and the spatial behavior of the internal users of the traditional architecture

3 Identification of Landscape Genes of Huizhou Ancient Villages

3.1 Identification principles

Huizhou's ancient village landscape system is rich, in identifying landscape genes, it can be based on the basic form of landscape elements, i. e. three basic forms of point, line, and surface, or according to the identification principles of landscape genes: intrinsically unique, externally unique, locally unique and overall advantage four principles, [7], [8]. The traditional village landscape gene identification method is constructed in terms of

structure, form, meaning, elements, etc. The specific identification system relationship is shown in Fig. 1.

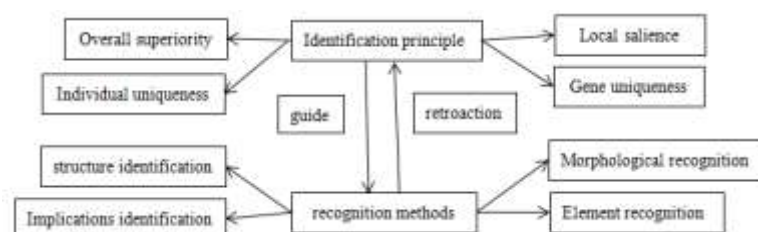


Fig. 1: Landscape genetic theory identification system

Here the two are combined to identify the landscape genes of Huizhou ancient villages based on the

identification principles at the level of three elements. Intrinsic uniqueness, landscape genes formed for reasons that other villages do not have, extrinsic uniqueness, landscape elements, a composition that other villages do not have, local uniqueness, other villages do not have, local but more critical elements, overall advantage, landscape elements that are prevalent but particularly prominent in the village. Combined with the point, line, and surface elements the Huizhou village landscape genes are identified as village space form, village water system form, public space, residential architecture, sign structures, and decorative materials (Fig. 2).

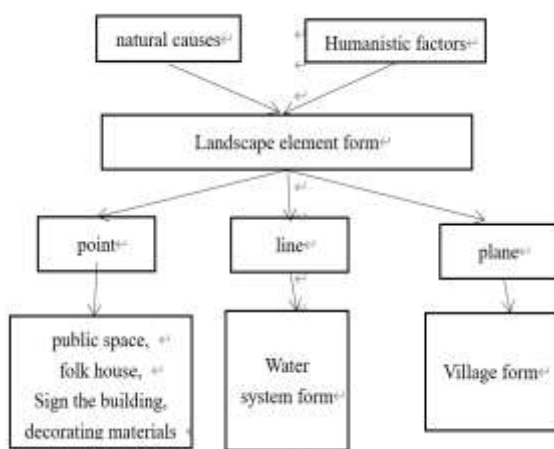


Fig. 2: Gene identification mode of Huizhou ancient village landscape

3.2 Landscape Genes Identification

3.2.1 Village Spatial Morphology

The morphology and spatial layout of Huizhou's ancient villages are influenced by the specific nature and regional culture of Huizhou. In the early period, Huizhou villages were restricted by the natural environment, and most of them existed in free form, such as along rivers and hillsides, etc. At this time, the village form was mostly regimented and linear, [9], [10]. Later, the clan ritual and legal system controlled the formation and development of villages, and the clustering type villages began to be formed, which were planned by feng shui geomancers, with the clan ancestral hall as the center, and the “snowball” type form was built outward in the order of respect. With the strong financial support of Huizhou merchants, the village form is laid out according to some specific psychological needs, to hold a special spiritual symbol, among which there are “boat-shaped” Xidi, “buffalo-shaped” Hongcun, “fish-shaped Fish-shaped” Yuliang Village (Fig.3) and other pictorial

villages.



Fig. 3: Plan of Yuliang Village

3.2.2 Village Water System Form

The ancient villages in Huizhou have complex topography, abundant precipitation, and a dense water system, so Huizhou people have a set of mature water management methods. Huizhou villages are often built beside mountain valleys, and the water system can flow along the edge of the village, it can also pass through the village and become the main line of the village. The village uses the topography to bring the water from a high place and goes through the whole village to facilitate the use of the whole village. Such a water line can also be used as a street of the village, with stone slabs on top of the gutter for ground and water-friendly purposes, [11], [12]. In addition to the linear water system, ancient villages are more often surface-shaped waters, such as the mouth of the water. The surface waters are generally formed by the collection of linear water systems and are the public space of the village. In addition to meeting the daily needs of the function, they are more important for drought and flood control, fire-fighting, and disaster prevention. The water form is variable, and merchants are willing to provide funds to build a more aesthetic waterscape.

3.2.3 Public Space

(1) Ancestral hall. In the general environment of Huizhou clan society and the strong support of Huizhou merchants, the construction of public buildings often has a very important metaphor. The ancestral hall is the symbol of the Huizhou clan and the core of the village, and is the external form and physical carrier of clan culture, in addition to genealogy and ancestor worship activities, [13], [14]. Each courtyard is relatively high to show the

meaning of ascending step by step. The ancestral hall is divided into a patio style and a gallery style, mainly consisting of several triple courtyards set together, with a relatively open interior space. The overall architectural style is grand and imposing, with windowless and undecorated walls, largely white areas, contrasting with the green tiles on the roof, and the contrast between the light and dark of the hall and the patio, emphasizing the solemn and mysterious atmosphere of the ancestral hall. In the details, because the ancestral hall is limited in color, carving techniques are used extensively. The complex craftsmanship is used to bring the ancestral hall closer to the imperial grandeur to show the importance the ancient Huizhou people attached to the ancestral hall.

(2) Study hall. The academy, on the other hand, is mostly founded for the sons and daughters of the clan and is a place for clan education and talent cultivation. Based on the characteristics of residential architecture, public buildings such as ancestral halls and study halls are more hierarchical, and their scale is generally two or three quadrangle courtyards, with the best craftsmanship, the most rigorous carving and decoration, and rich spatial levels to give people a sense of solemnity, [15], [16].

(3) Shuikou. The embodiment of astronomical and geographical views. Huizhou people observe the sun rising in the east and setting in the west, the river from west to east, that the most ideal planning pattern of village site selection is beside the river from northwest to southeast. Tangmo Village is a typical Shuikou Village. Huizhou people believe that the location and environment of the water mouth are related to the village's fortune and the rise and fall of the clan, so the location of the water mouth is valued. Shuikou is often based on the direction of the mountain, at the turn of the mountain range or the confrontation of two mountains, surrounded by clear streams, and in the same direction as the village entrance. If the village is back to the mountain, its river from the two mountains outflow, then this is ideal. At the beginning of the village landscape, Shuikou is a comprehensive Shuikou garden with strong regional characteristics, including a natural landscape, various buildings, flowers and trees, and carvings. The water in the confrontation between two mountains reflects a "paradise" like beauty, and the water mouth integrates the surrounding natural environment and artificial structures to form the unique water mouth landscape of Huizhou.

3.2.4 Residential Architecture

(1) Shape and structure. The residential houses choose the advantages of both dry bar style and courtyard style. Huizhou is restricted by the natural environment of dense mountains and water, so it is difficult for the villages to expand outward in a faceted way, and the population is still growing, which leads to more and more tension in the land of the villages. Facing such a problem, Huizhou people choose a compact layout to save land, mostly in the form of three walls and one room, and the building is mostly two-story. The housing is in the form of multiple courtyards with "patio + courtyard", forming high houses and deep gardens that are flexibly arranged according to function and scale, [17], [18].

(2) Roof (horse head wall). Most Huizhou dwellings have hard roofs, and the two sides are high roofs with horse-head walls, and the two sides are covered with green tiles. The roof adds a unique charm because of the horse-head wall. The initial use of the horse head wall was for fire prevention, but later it evolved into anti-theft and wind prevention. When the village developed and expanded, it became a decoration to save the land and connect neighbors. Later on, it changed from a general fire sealing wall to a horse head wall as a unique landscape element in Huizhou. The horse-head wall is an indispensable landscape element of Huizhou architecture and has become the most characteristic landscape gene of Huizhou after long-term development.

(3) Patio. The embodiment of the unity of heaven and man. "The internal space of the dwelling has a strong sense of closure because of the tall outer wall, and the "patio" is set up as an open space. The establishment of the patio is deeply influenced by the historical environment and humanistic concept of Huizhou, and the water on the roof converges to the yin well through the patio, which is the visualization of gathering water as gathering wealth and "fat water does not flow out". The patio is an open space enclosed by the main house and high walls for ventilation, light, and drainage. The patio is the center of the enclosed inner courtyard, and other basic building units are set up around it, with common structures such as concave, H-shaped, and mouth-shaped, [19], [20].

3.2.5 Sign Structures

The pagoda, the residence, and the ancestral hall are called the "three best things in Huizhou". As a derivative of ancestral halls, pagodas are used to commend merits and protect the interests of feudal clans. Against the background of powerful clan strength and a strong economic foundation, the

number and scale of pagodas in Huizhou have reached the top. Regardless of the high official position or chaste reputation, pagodas are erected, which is the embodiment of Huizhou people in Confucian political theory and moral and ethical concepts. The pagoda is a combination of architecture and carving, set in a prominent position in the village, in front of the village entrance, intersection, and ancestral hall, and the overall height is spectacular and beautifully decorated. The form is divided into rushing type, such as Tangyue village pagoda group (Fig.4), pagoda type, such as Xidi Jiaozhou Assassins Square (Fig.5), the function is divided into sign square, merit square, and centennial square, etc. pagoda is a special landscape element representing the patriarchal thought and the identity of the master, showing the cultural landscape of the village, highlighting the Huizhou concept of patriarchy, [21].



Fig. 4: Tangyue village pagoda group



Fig. 5: Xidi Jiaozhou Assassins Square

3.2.6 Decoration Materials

(1) Wood carving. Huizhou is rich in forest resources, and wood is used more in the construction of residential houses. Wood carving is generally formulated according to the specific needs of the building, and round carving, relief carving, and perspective carving are all common techniques of carving. Wood carving is the main form, mainly

used for doors, beams, grilles, skylights, and furniture. From the initial scale in the early Ming Dynasty to the mainstream techniques after the middle of the Ming Dynasty, wood carving has become the essence of Huizhou folk art, [22].

(2) Brick carving. Brick carving is fresh and elegant, more decorated in the fine parts of buildings, such as door hoods, door towers, window heads, and ends of horse head walls. The brick carving uses the green and gray bricks produced in Huizhou and selects the theme patterns with ethical and edifying significance. Brick carving is a typical skill inherited for thousands of years, taken from local materials and adapted to life. As the decorations of Huizhou architecture, its higher practicality, ornamental and cultural meanings become the unique landscape genes of Huizhou ancient villages.

(3) Stone carving. Stone carving is thick and dashing, less used, and commonly used in the base of residential houses, ancestral halls, and pagodas. Stone carving has a long history, and the stone carving of Huizhou ancient villages is taken from green and black marble, with profound regional characteristics, [23].

4 Strategies of Traditional Village Inheritance Protection based on Landscape Genes

4.1 Integrate Landscape Gene Information and Clarify Protection Priority Level

The genetic elements of traditional village space form are a two-way process of inheritance and variable development, which keeps changing with social development and lifestyle transformation. The cultural activities such as clan rituals, folk customs, and religious beliefs of traditional villages in Huizhou have changed with the development of modern society. The villagers combine the traditional cultural customs with the modern society to show a cultural atmosphere that meets the needs of contemporary society and retains the characteristics of traditional life, to realize the adaptation of the historical culture of Huizhou traditional villages with social development and the regeneration and continuation of the connotation spirit of the villages. In addition, the spatial function of a traditional village accompanies the change of social environment and family to meet the needs of the village's socio-economic development. At the same time, the architectural courtyard space is the most changeable spatial element in the traditional village spatial form. It changes with the change in

the building construction process, materials, and environment, while the traditional street space and marked node space change with the change in the overall spatial environment of the village. Therefore, in the process of inheritance and protection of the cultural landscape of traditional villages in Huizhou, it is a key step to deeply excavate the landscape characteristics of traditional villages, clarify the content of the regional landscape, identify and extract the landscape genes of traditional villages and integrate the genetic information of the genes, and sort out the main landscape genes of existing landscape genes of villages that fit the historical lineage of village development, [24]. The clarification of the importance level among landscape genes and the implementation of the protection priority of landscape elements in traditional villages can make the protection planning of traditional villages more scientific and effective.

4.2 Revitalize Village Landscape Elements and Create Characteristic Landscape Imagery

Different landscape gene combination has different landscape effect, in gene identification, great value but the degree of obvious factors, the landscape elements (gene) are gradually lost in the process of traditional village development, and the current traditional village heritage protection needs to be implemented is activate the corresponding landscape elements, form the characteristic landscape effect. For example, in the protection and development mode of Hongcun, the private enterprise spent a huge amount of money to cooperate with an international team to create a large-scale live-scene cultural stage drama named "Hongcun Aju" with the background of ancient Huizhou culture. The stage play reproduces the strong image of Huizhou women who are thrifty, teaching and raising children, faithful, and defending their homes. With "the macro village, chrysanthemum" and other entity stages for the template of artistic creation, not only make the ancient Huizhou culture story, and historical context, in the process of broadcast activate the corresponding Huizhou cultural landscape, such as window display, lion dance and lantern + light, architecture, dance show, and through actor costumes, architectural form, architectural decoration style, fully present the period of social aesthetic concept, activate the historical period of Huizhou traditional village of social form, to create Huizhou characteristic landscape. At the same time, the existing building in Pingshan Village, "Imperial

Guard", has been transformed into a coffee restaurant bar and a homestay. On the premise of retaining its original landscape features, it changes its functional attributes and service objects. The transformation mode integrates protection and development, which not only activates the ancient traditional villages and buildings, and makes them have different images of The Times in the development of The Times, but also creates landscape types that meet the needs of modern people so that participants can not only enjoy the traditional old buildings of Huizhou but also meet the needs of leisure and entertainment. So draw on the empirical model of such cases, for some ancient villages where ancient buildings are in disrepair, we should take landscape genetic mapping as the basis, clarify the historical formation of village landscape elements, combine the temporal order and importance of landscape genes, activate village landscape elements, and clarify their construction subject, service object, functional positioning and other attributes, re-planning and designing the landscape elements, replacing the functions of hollow houses, vacant house bases and residential buildings with the will of transformation, forming an integrated architectural space for entertainment, accommodation and catering, and landscaping the wasteland to become a place for tourists to watch and learn, realizing functional transformation, so as to revitalize the village landscape elements in a targeted manner and create characteristic landscape intention, and comprehensively build the development strategy of rural tourism, [25].

4.3 Protect the Living Cultural Landscape and Improve the Inherited Cultural Value

Retracing the spatial state of the "prototype" of traditional Huizhou village spatial form in each historical period, maintaining the true expression of the genetic elements of village spatial form, [26]. At the macro spatial level, we maintain the original spatial environment pattern and historical and cultural connotation of the village, and based on this, we improve the protection and repair of the spatial genetic elements of the village based on the spatial patterns and features of the village in each historical period, to maintain the originality of the spatial genetic elements of the traditional village to the greatest extent. In addition, it establishes a corresponding protection mechanism and sets up a relevant award system to help the long-term survival of the intangible cultural heritage of Huizhou, including the inheritance of artisans, the continuation of crafts, and the protection and management of books such as related historical

documents, etc., to fundamentally protect the living cultural landscape, improve the value of inherited culture, and implement the protection measures of “repairing the old as the old, managing in place The protection measures such as “repairing the old as the old, managing in place” are implemented, and finally the protection mechanism of traditional villages in Huizhou is implemented.

5 Conclusion

Huizhou's ancient village landscape is the embodiment of Huizhou's cultural values based on the natural environment and is influenced by a combination of factors. Feng Shui guides the form and layout of the village and uses the landscape environment to form the initial form of the village landscape, the clan dominates the development of the village, and the village landscape under the influence of ritual and law system has strong clan characteristics, and the clan becomes the driving factor of the development of the village landscape, the Hui merchants use capital to expand the scale of the village landscape construction, and combine the clan and science to establish educational institutions such as academies, which further enriches the village landscape. It can be said that clans, Huizhou merchants, and science are all intrinsic driving forces in the formation of ancient village landscapes with regional characteristics of Huizhou. Each village has universality and uniqueness. Using landscape genes to define ancient village landscapes inherited to this day and identifying landscape genes with historical and humanistic meanings can effectively improve the identification of traditional village landscapes in the Huizhou region and provide certain references for the protection and development of traditional villages in China. However, due to the limited research time and the lack of data collection and collation, the research results have certain shortcomings. Based on this, in the later research process, we will continue to improve the collection of relevant data on Huizhou ancient villages and conduct corresponding research using more landscape genetic research methods, so as to provide certain references for the efficient development of the spatial characteristics of traditional villages and their heritage protection.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

Hao Wu has made a significant contribution to the revised draft, provided the related concepts and minor recommendations, extracted the conclusion and discussion, modified the article, added relevant literature, and made polish the article. Tian Liang contributed to the motivation, the interpretation of the methods, the data analysis and results, and provided the draft versions and revised versions, references. Tao Shen provided the data and results, the revised versions and references.

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